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Review

The evolution and utility of the burn specific health scale: A systematic review[☆]

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ABSTRACT

The Burn Specific Health Scale (BSHS) is the most commonly used instrument used to evaluate burn survivors' quality of life (QOL). Multiple forms of the instrument exist; however, the literature lacks clarity in regard as to why a particular version of the BSHS was used and how the instrument performed in a variety of samples. This paper provides a review of the literature of the variations of the BSHS, its utility for research and clinical practice, and scoring concerns.

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Contents

1. Quality of life (QOL)	1144
2. Methods	1144
2.1. Rationale for method	1144
2.2. Inclusion/exclusion criteria	1144
2.3. Search strategy	1144
3. Findings	1145
3.1. The evolution, psychometric testing, and limitations of the BSHS	1145
3.2. Burn Specific Health Scale-Abbreviated	1145
3.3. Burn Specific Health Scale-Revised	1153
3.4. Burn Specific Health Scale-Brief	1153
3.5. Utility: a comparison of the BSHS-A, BSHS-R, and BSHS-B	1154
4. Areas of concern	1154
5. Conclusion	1154
References	1155

There are approximately 1 million burns annually in the United States, with just over 500,000 emergency department and outpatient clinic visits and 40,000 hospitalizations, per year [1]. Deaths from fires and burns are the fifth most

common cause of unintentional injury deaths in the United States and the third leading cause of fatal home injury [2]. Overall, the incidence of burns has declined from 10 per 1000 in the 1950s to 4.2 per 1000 in the 1990s due to increased

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prevention in the home and workplace [3]. Since World War II, marked advances in the clinical management of burns have resulted in increased survival rates and normal life expectancies for burn victims who would have previously succumbed to their injuries. Consequently, the overall mortality rate from burns has declined by nearly 30% due to advances in acute burn management and sepsis techniques.

All of these factors combine to produce a greater number of burn survivors facing substantial long-term rehabilitation and life-long physical, social and psychological challenges. A burn is one of the most traumatic assaults on a human being and has the potential to totally destroy or, at least, disrupt many aspects of a patient's life [4]. The increased survival rates highlight the need to better understand complex rehabilitation issues such as pain, amputations, scarring, and quality of life (QOL) issues such as functional, emotional, and social readjustment [5].

Sudden and serious burn precipitates cognitive and emotional challenges that affect the course of recovery. To the extent that the burn changes the victim's life, their overall quality of life is affected. The young adult who recovers from burn injury is required to focus considerable energy into regaining ways of functioning in the world, into handling the fears and frustrations that inevitably develop, and into redefining themselves as the persons they are to become if their injuries leave them with disabilities. Of patients hospitalized with major burns, approximately 83% survive. Because of the marked reduction in burn-related deaths, the importance of burn rehabilitation has come to forefront of the burn literature [6–8]. The increased survival of burn patients has required clinicians and researchers to look beyond mortality statistics and to consider how a thermal injury affects a patient's long-term adjustment and QOL. There are tremendous QOL issues concerning burn patients, but there is a paucity of literature regarding this topic as well as a lack of a universally accepted conceptualization.

1. Quality of life (QOL)

Health care providers and researchers may be using various terms, such as physical functioning and QOL, to explain what may be termed as "rehabilitation" by individuals in physical medicine [9]. This point is well taken in light of the fact that "quality of life" has been poorly defined, when defined at all. Currently, there is no universally agreed upon definition of "quality of life" [10]. The World Health Organization defined QOL as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" [11]. More recently, there is agreement that QOL is a multidimensional, multi-factorial mosaic [12]. Furthermore, it has evolved from a global concept to one with specified and measurable domains [13]. In defining QOL it is important to note that the construct is not static; it is capable of changing dramatically for better or worse over time. Additionally, qualitative research has demonstrated that QOL is a dynamic concept with diffusion across domains [14].

Most often within the burn literature QOL is reflected as a multidimensional concept that consists of the following dimensions: functional well-being (focuses on activities of daily living and occupational functioning), emotional and

spiritual well-being, treatment satisfaction, economic well-being, social functioning, relationships with family, and sexual functioning/intimacy [4,15–16]. Munster [17] highlighted factors that place burn victims at greater risk for poorer QOL. These include pre-injury factors such as premorbid psychiatric disorder and personality characteristics, peritraumatic factors such as percentage total body surface area (TBSA) and posttraumatic distress, and post-burn factors such as body image dissatisfaction. Notably, those burn patients with psychiatric comorbidities, posttraumatic distress and body image dissatisfaction have the most difficult time with post-injury adjustment and establishing a more positive view of QOL [18–19].

Many clinicians and researchers agree that functional outcomes of burn care such as the resumption of independence in self-care activities, home management tasks, work responsibilities, and the resumption of leisure activities need to be more thoroughly examined [5,20]. In response to inadequate measurement tools that accurately reflected the social, psychological, and functional outcomes in burn patients, a team of investigators from the Baltimore Regional Burn Center [15] created the original Burn Specific Health Scale (BSHS). This instrument has undergone extensive psychometric testing and revision over the last 25 years and has been widely used as a measure of short and long-term outcomes in burn patients. Therefore, the purpose of this systematic review of the literature is to describe the evolution of the instrument and the current state of psychometric testing for the various versions as well as to highlight its utility and limitations when measuring outcomes in burn patients.

2. Methods

2.1. Rationale for method

In the 1990s, a process known as a systematic review of the literature was first formalized within the medical community [21]. Its primary purpose was to inform practice and policy and identify any gaps in the knowledge. For the purposes of this paper, the process of systematic review was used to examine burn research using the BSHS and its various versions that appear within the literature. Furthermore, the evolution of the BSHS and the current state of psychometric testing for each version of the instrument will be described along with the utility and limitations of each instrument when studying QOL in burn patients.

2.2. Inclusion/exclusion criteria

Qualitative and quantitative studies that used any complete version of the BSHS were included in this systematic review, as well as studies that psychometrically tested any version of the BSHS on burn patients. Only studies published in peer-reviewed journals were included.

2.3. Search strategy

The initial search was completed in February 2009 and included articles published between January 1979 (the date

of creation of the original BSHS), and February 2009. The electronic databases searched were: MEDLINE, CINAHL, and the Cochrane Library. The following keywords: were searched within the text: Burn Specific Health Scale (BSHS); BSHS-Abbreviated (BSHS-A); BSHS-Brief (BSHS-B); and BSHS-Revised (BSHS-R). The references of review articles and of included original publications also were examined for any relevant studies. Abstracts from 42 articles were reviewed and retrieved for relevance. Of those reviewed 40 articles were retrieved and further screened for inclusion. Of those retrieved; 28 were relevant for inclusion in this review (see Table 1).

3. Findings

Of the 28 articles identified for inclusion in this systematic review, two described the development of the original 114 item BSHS; eight described psychometric testing or the use of the 80 item BSHS-Abbreviated version (BSHS-A); three described the development, psychometric testing and use of the 31 item BSHS-Revised version (BSHS-R); 13 described the psychometric testing and use of the 40 item BSHS-Brief version (BSHS-B), and two psychometrically tested and compared the latter three versions. To further classify the specific purpose of the 28 studies, 11 involved psychometric testing of one or more versions of the BSHS, 15 involved the actual use of one version of the BSHS to explore a research question related to survivors of burns, and one study did both (see Table 1).

3.1. The evolution, psychometric testing, and limitations of the BSHS

In response to inadequate measurement tools that accurately reflected the social, psychological, and functional outcomes in burn patients, Blades et al. [15] created the original BSHS. The original instrument was comprised of 114-items divided into eight subscales that measured the health status among survivors of burn injuries. The instrument began as a list of items from the Sickness Impact Profile (SIP), the Index of Activities of Daily Living, and the General Well-being Schedule. A survey of burned patients and the staff from the Baltimore Regional Burn Center provided an additional 160 items that were believed to provide relevant information not included in the three general scales. The complete catalog of 369 items was circulated to a group of 35 judges composed of professionals with expertise in burn treatment and rehabilitation and a group of former patients, stratified by time post-burn and by burn site. Content validity was established by the judges who were assigned the task of rating each item on an 11-point scale according to its relevance in assessing the post-burn performance of patients. Preliminary analyses of the alpha coefficients for internal consistency/reliability for each of the six major domains identified were: physical health 0.86; body image 0.83; psychological health 0.92; sexual health 0.86; physical activities 0.74; and family/social relationships 0.55 [16].

The creators of the instrument made a number of assumptions when they developed the BSHS: the instrument should not rely on the patient's pre-injury level of functioning,

because this is almost impossible to validate, and the scale should be comprehensive, yet it should be self-administered and short enough to assure patient compliance and acceptance by other professionals [16]. The 114 items of the BSHS were refined, duplications and inconsistencies were omitted, and the 80 items that received the highest median ratings by all the judges were then used as the nucleus for the BSHS-A version. Additionally, the direction of the questions, which had previously been mixed functional and dysfunctional, was simplified and positively oriented. Alpha coefficients for internal consistency/reliability estimates of the BSHS-A were high in four domains: physical health (0.86); body image (0.83); psychological health (0.92), and sexual health (0.86). Both intrarater and interrater reliability showed positive correlations: $r = 0.89$; $p < 0.001$ and $r = 0.78$; $p < 0.05$, respectively [22].

3.2. Burn Specific Health Scale-Abbreviated

The BSHS-A measures four specific domains, three of which have subdomains. The literature categorizes the four domains of the 80-item BSHS-A as: physical (items 1–20); psychological (21–50); social (51–65); and general (65–80). The Physical domain can be divided into: mobility/self-care (1–10); hand function (11–15); and role activities (16–20). The Psychological domain can be divided into body image (21–27) and affective (28–50). The Social domain can be separated into family/friends (51–62) and sexual activity (63–65). The General domain (items 66–80) captures burn specific impairments such as pain, social sensitivity, and health. The Global score includes items 1–80 [16].

The BSHS-A asks patients to rate their degree of difficulty concerning the 80 burn specific items. The items are scored using a five point Likert scale with "0", none at all; "1", a little bit; "2", moderate; "3", quite a bit, and "4", extreme [16]. A score is derived by dividing the total score for a domain or subdomain by the total possible score. Resultant scores range from 0.00 to 1.00. Higher scores indicate greater functional adaptation and fewer problems [10,16,22–23].

According to Munster et al. [22], the scale contains a single duplication in questions 27 and 30. Question 27 reads "I am uncomfortable around other people" and question 30 reads "I feel uncomfortable around other people." Patients who reply to these items with a difference of greater than 1 point in their answers are supposed to be eliminated from the study. However, no rationale for this guideline was discussed in the literature and no study could be found where this guideline was followed. Furthermore, these questions are not exact duplicates and depending on interpretation, can be construed as having different meanings by respondents.

In addition to the English version, the BSHS-A was translated, and reliability and validity established, in Spanish and Norwegian versions. More recently the instrument was translated into Brazilian-Portuguese and psychometrically tested [24–26]. Although the original psychometric development of the BSHS-A had been rigorous, the research team continues to refine the reliability and validity of the scale and to develop normative scoring data [27]. Moreover, the BSHS has been used consistently and extensively within the area of burn research to study the physical and psychosocial functioning of burn patients [10,28,29].

Table 1 – Burn specific health scale articles.

Authors (date)	Purpose	Method	Sample	Instruments	Outcomes
Blades et al. [15]	Pilot study of newly developed BSHS measure of QOL in surviving burn patients	Descriptive correlational using survey and interview; cross-sectional; retrospective	32 burn patients	- Semi-structured interview by social worker - Joint function evaluation by Occupational Therapist - Author developed scale of pre-BHS measuring 5 equally weighted areas of performance: work, dependence, joint function, psychosocial, and subjective	- 12 months elapsed before statistically significant improvements in ratings of overall QOL in burn patients - Scores on QOL measure did not differ depending on size of injury - Preliminary investigation to determine need for development of reliable and valid BSHS to measure QOL in burn patients
Blades et al. [16]	Psychometrically test the original 114 item BSHS	Cross-sectional survey; retrospective	40 adult burn patients discharged from Baltimore Regional	- 114 item original BSHS - The Sickness Impact Profile - Index of Activities of Daily Living - General Well-Being Schedule	- Content validity established through group of 35 judges composed of professionals in the field of burn treatment and rehabilitation and group of former burn patients - Items worded both negatively and positively with appropriate corrections are made, in grading, of positive items - Final score expressed as a percent of the maximum - Alpha coefficients of internal consistency/reliability analysis: physical health 0.86, Body Image 0.83, psychological health 0.92, sexual health 0.86, physical activities 0.74, and family/social relationships 0.55 - Internal consistency analysis measured highest degree of reliability in three domains: physical, affective, and Body Image - Problem: rescoreing of negatively worded items not fully addressed
Munster et al. [22]	To finalize and validate 80 item BSHS-A	Descriptive, correlational cross-sectional, retrospective	70 burn patients discharged from Baltimore Regional Burn Center	- BSHS-A	- Internal consistency/reliability estimates were consistently high on major domains with alpha of 0.86 for physical health, 0.83 for Body Image, 0.92 for psychological health, and 0.86 for sexual health. - Intrarater reliability: $r = 0.89$, $p < 0.0001$; interrater reliability: $r = 0.78$, $p < 0.05$. external criterion validity for physical section $r = 0.605$, $p < .05$ and psychological section, $r = 0.78$, $p < 0.05$
Blalock et al. [30]	Examine content validity of BSHS by comparing items within instrument with list of problems identified by survivors of burn injury	Qualitative interview	38 participants who received inpatient treatment for moderate to severe burns at a university-affiliated burn center in southeastern U.S.	- Open-ended interview questions on (1) problems associated with their burn injury, (2) rehabilitative goals, (3) factors that facilitated rehabilitation process 4) Perceived barriers to rehabilitation process	- Content validity: based on interview responses and evaluation of BSHS, problems with skin, work, treatment regimens, pain, and itching are not adequately covered. - Aspects of functioning and appearance were the primary rehabilitative goals identified. - Support from health care providers were listed more often as facilitators to recovery than family and friends (both technical and affective support equally). - Physical factors identified as primary barrier to recovery

Pruzinsky et al. [27]	Describe psychometric assessment instruments available for screening of psychosocial problems that can interfere with burn patient rehab	n/a	n/a	Brief description of recommended screening tools, including 80 item BSHS-A. No psychometric properties given.	- Article outlines psychosocial factors, social factors, personality and coping styles, QOL and health status
Blalock et al. [32]	Examine factors associated with psychological distress among survivors of burn injury	Descriptive, correlational, cross-sectional, retrospective	216 burn patients within 2 years of discharge from initial inpatient treatment at one of seven burn centers in Southeastern U.S.	<ul style="list-style-type: none"> - CES-D - Speilberger's State-Trait Anxiety Inventory - Rosenberg's self-esteem scale - Affect subscale from BSHS-R - Avoidance and Intrusion subscales from Mississippi Scale for combat-related PTSD - BSHS-R - Sociodemographic Variables 	<ul style="list-style-type: none"> - Having low outcome expectations for improvement combined with attaching high importance to the need for improvement was significantly associated with increased psychological distress. - Greater psychological distress was associated with more physical health problems. - Gender and length of stay were factors associated with combination of high perceived importance and low expectations.
Blalock et al. [31]	Examine reliability of a revised version of Burn Specific Health Scale	Descriptive, correlational, cross-sectional, retrospective	254 burn patients from eight burn centers in southeastern US	<ul style="list-style-type: none"> - 80 items from original BSHS that measured domains of: Mobility and Self-Care, Hand Function, Role Activities, Body Image, Affective, Family/Friends, Sexual Activity, and General Health Concerns - 29 items added to scale to assess work, skin sensitivity, pain, treatment regimens - Validation analysis performed through CES-D and STAI (Cronbach's alpha 0.92 and 0.95, respectively), and five items adapted from McGill Pain Questionnaire, RADAR, and Arthritis Impact Measurement Scale to validate created pain subscale. 	<ul style="list-style-type: none"> - Factor analysis resulted in seven subscales consisting of 31 items, 17 from original BSHS and 14 added items. Revised subscales less highly intercorrelated but have adequate internal consistency (Cronbach's alpha ranging from 0.82 to 0.94) - Factorial validity analysis yielded six factor solution explaining 72.3% total variance (Affect and Body Image emerged into single factor) - Correlations between original BSHS and revised subscales were high (0.91 for Affect, 0.89 for Body Image, and 0.92 for Interpersonal Relationships) - Construct validity of revised subscales correlated with five other measures - Lack of discriminant validity between Affect and Body Image Subscales - New instrument 31 versus 80 items <p>Problems: should have provided summary comparison table of both instruments; incorrectly states that original BSHS had 80 items; In this article the final instrument was never named</p>
Baker et al. [28]	Identify predictors of psychological and physical functioning of the victim with burn injuries from initial hospitalization to discharge	Descriptive, correlational, prospective, longitudinal	31 burn patients admitted between March 1989 and July 1990 at a Midwestern regional burn center.	<ul style="list-style-type: none"> - BSHS: 80 item (assumption that it was the BSHS-A) - Chart review for independent variables, degree of burn and location of burn, and length of stay - Patients sampled at first alert and then again at discharge 	<ul style="list-style-type: none"> - Reliability coefficients for each domain (Physical = 0.83, Mental = 0.84, Social = 0.79, General = 0.80). - Degree of burn, location of burn on hands or face and longer length of stay was associated with poorer psychological and physical functioning.

Table 1 (Continued)

Authors (date)	Purpose	Method	Sample	Instruments	Outcomes
Kimmo et al. [35]	Measure both physical and psychosocial functioning after recovery from burn injury using BSHS-A	Descriptive, correlational, cross-sectional, retrospective	124 patients treated at Toolo Hospital Burn Unit from November 1988 to December 1994	- BSHS-Abbreviated 62 item scale	<ul style="list-style-type: none"> - Mobility, self-care, and Hand Function were significantly affected by severity of burn - Increased hospital length of stay was associated with decrease in mobility and self-care - Patients with full-thickness burns had poorer Body Image. <p>Problem: used 62 item abbreviated version of BSHS-A and provided no assessment of reliability or validity</p>
Sanz et al. [26]	Study the viability, reliability, validity of the Spanish version of the BSHS	Descriptive, correlational, retrospective	115 burn patients hospitalized from October 1989 to November 1995 at the Alicante General Hospital Burn Care Unit	- BSHS-A: translation by 3 bilingual translators, feasibility tested in 29 patients, test-retest reliability by 41 patients over 10 day interval, criterion validity through patient performance of simple actions under observation, and internal validity by 115 patients	<ul style="list-style-type: none"> - 5–20 min to complete - Test-retest reliability ranged from 0.911 to 0.979 - Internal reliability: 0.96 overall and individual domains ranged from 0.65 to 0.95 - Criterion validity: all scores were statistically significant - Final conclusion: Spanish version is a feasible, reliable and valid instrument
Taal and Faber [39]	Assess the reaction to burn trauma, the hospitalization characteristics and the psychosocial adjustment	Descriptive, correlational, retrospective	174 Dutch-speaking burn patients admitted from January 1994 to December 1995 to one of 95 Dutch hospitals for burn injury	- Anxiety-Depersonalization Scale - Impact of Events Scale - Symptom Checklist-PTSD - Loneliness Scale - Social Isolation Schedule - Burn Psycho-Somatic Morbidity Scale (BPSM) - Hospitalization characteristics	Does not use BSHS in this study however results show the visibility of burns was not predictive of feelings of shame however social introversion was a factor significantly associated with the development of burn-related feelings of shame
Kildal et al. [33]	To use a factor analytic approach to further improve the BSHS and develop the BSHS-B	Descriptive, correlational, cross-sectional, retrospective	348 burn patients (TBSA >10%) treated between 1980 and 1995 at Uppsala University Hospital Burn Center	- BSHS: 114 items, eight domains, four subdomains - BSHS-A: 80 items, four domains, eight subdomains - BSHS-R: 31 items, 7 domains - BSHS-B: 40 items (same as BSHS-R plus items on Hand Function and Sexuality)	BSHS-R: 40 items with nine factors derived representing 72% of the variability. Factor intercorrelations ranging between 0.11 and 0.56 and with Chronbach's alphas ranging between 0.75 and 0.93 suggesting very acceptable intrafactor homogeneities
Willebrand et al. [40]	Investigate coping patterns, health status and personality traits in burned adults.	Cross-sectional, survey, retrospective	161 burn patients with burns >10% TBSA treated at Uppsala University Hospital between 1980 and 1995	- BSHS-brief version (BSHS-B): 40 item inventory with 9 subscales; measure simple abilities, Heat Sensitivity, Hand Function, treatment regimens, work, Body Image, affective, interpersonal relationships and Sexuality; Cronbach's alpha 0.75–0.93. - Coping with Burns Questionnaire (CBQ) - Swedish Universities Scales of Personality (SSP)	<ul style="list-style-type: none"> - ANOVAs significant for seven BSHS-B subscales: simple abilities, Heat Sensitivity, work, Body Image, affective, interpersonal relationships, and Sexuality. - Extensive copers had significantly better health status than avoidant copers on 2 subscales" affective and interpersonal relationships. - Adaptive copers had significantly better health status than avoidant copers on six subscales (Heat Sensitivity, work, Body Image, affective, interpersonal relationships, Sexuality) and significantly better health status than extensive copers on three subscales (simple abilities, work, affective). - Overall, avoidant copers had lowest health status

Kildal et al. [29]	Compare the BSHS-A (Abbreviated), BSHS-R (Revised) and BSHS-B (Brief)	Cross-sectional, survey, retrospective	248 former burn patients treated at Uppsala University Hospital Burn Unit 1980–1995	<ul style="list-style-type: none"> - BSHS-A: 80 item version containing four main domains and eight subdomains: high internal reliability for the main domains with alpha coefficients between 0.83 and 0.92; acceptable interrater and intrarater reliabilities and external criterion validity. Instrument not factor analyzed and problems in the areas of treatment regimens, work, skin sensitivity, and pain were not well covered. Also lack of discriminant validity between BSHS-A scales. - BSHS-Revised: 31 item with principal component analysis yielding 6-factor solution corresponding to BSHS-A without specific coverage of domains Sexuality and Hand Function. Alpha's range from 0.82 to 0.94. - BSHS-Brief: 40 items (31 from BSHS-R plus nine items to address Hand Function and Sexuality. Nine factor solution with alpha's ranging from 0.75 to 0.93 	<ul style="list-style-type: none"> - Scores on all three instruments highly correlated, least between BSHS-A and BSHS-R ($r = 0.81$, higher between BSHS-A and BSHS-B ($r = 0.86$) and strongest between BSHS-R and BSHS-B ($r = 0.98$) - Internal reliability for all scales was high: BSHS-A ranging from 0.75 to 0.96, for BSHS-R from 0.75 to 0.93 and for BSHS-B from 0.75 to 0.93. <p>Problems: None; provides alpha's for all instruments and the subscales of each instrument based on adequate sample size.</p>
Cromes et al. [10]	Determine change over time in quality of life (QOL); functional, community reentry, and psychosocial predictors of QOL	Descriptive, correlational, prospective longitudinal	Sample of adults with major burn injury 2 months after discharge ($n = 110$), 6 months ($n = 97$), and 12 months ($n = 69$)	<ul style="list-style-type: none"> - BSHS: 80 item (assumption that it is the BSHS-A) - Brief Symptom Inventory - Functional Assessment Screening Questionnaire - Additional Life Stressors - Functional Independence Measure - Pain Analogue Scale - Community Integration Questionnaire - Satisfaction with Life Scale 	<ul style="list-style-type: none"> - BSHS Physical Domain improved significantly from 2 to 6 months then remained stable. - No statistically significant changes across time for BSHS Global, General, Social, or Psychological domains - Less overall emotional distress and lower pain levels were associated with better QOL scores at 2 months; Less emotional distress, greater resumption of activities and lower pain level associated with better QOL scores at 6 months; lower emotional distress, greater involvement in activities were associated with better QOL scores at 12 month
Kildal [41]	Improve two existing versions of BSHS, assess long-term outcomes in a cohort of patients with burn injuries, and explore individual factors of personality and coping on perceived outcome	Descriptive, correlational, cross-sectional, retrospective	350 burn patients (TBSA >10%) treated between 1980 and 1995 at Uppsala University Hospital Burn Center	<ul style="list-style-type: none"> - Sickness Impact Profile - Nottingham Health Profile - General Well-Being Schedule - EuroQuol - Medical Outcomes Study -Instrument McGill Pain Questionnaire - Visual Analogue Scale - Lambeth Disability Scale - Social Health Battery - Quality of Life Index - Burn Specific Health Scale-A 	<ul style="list-style-type: none"> - Factor analytic approach was used to derive 40 item Burn Specific Health Scale Brief, resulting in 9 well defined domains (factor intercorrelations ranged 0.11 and 0.56 with Cronbach's alpha between 0.75 and 0.93). - Coping with Burns Questionnaire was developed with 6 clearly separated domains - Avoidant Coping Strategies and Neuroticism were strongly related to poor perceived health and contributed more to psychosocial than physical health - Most reported physical health problems related to Heat Sensitivity, Work, and Body Image. <p>Problems-None, includes Cronbach's alpha and factor loading for original BSHS, BSHS-A, and BSHS-B</p>

Table 1 (Continued)

Authors (date)	Purpose	Method	Sample	Instruments	Outcomes
Moi et al. [25]	Translation of BSHS-A into Norwegian and assessment of reliability and validity	Descriptive, correlational	11 patients confirmed BSHS-N was clear, understandable, and able to be self-administered - 95 patients admitted to Haukeland University Hospital Burn Center completed instrument, 69 completed retest	- BSHS-Norwegian - SF 36 - Face validity conducted by members of burn team, burn patients and professional translators; criterion validity assessed through SF-36; construct validity through known-groups validity; test-retest reliability.	Internal consistency in each health domain varied from 0.89 to 0.96 and in the subdomains from 0.77 in sexual activity to 0.95 in the affective subdomain. Overall value of the test was 0.97. Test-retest reliability of intra-class correlation ranged from 0.80 to 0.95. Face validity: mean time to complete survey was 22 min, 91% test-retest without missing any items. Criterion validity ranged from 0.62 to 0.81 between SF-36 and BSHS-N with associations significant in all domains. Construct validity discriminated significantly between groups of patients.
Kildal et al. [42]	Examine the relationship between personality traits and perceived outcome of burn injury	Cross-sectional, survey, retrospective	161 burn patients (>10% TBSA) treated at Uppsala University Hospital between 1980 and 1995	- BSHS-Brief (BSHS-B): 40 item, nine domain scale used to assess health status. Cronbach's alpha varied between 0.76 and 0.94 - Swedish Universities Scales of Personality (SSP)	Association between personality domain Neuroticism and poor outcomes in all BSHS-B domains, both psychosocial and physical Problems: none, only article that fully described progression of BSHS. Original BSHS (114 item) developed by Blades et al. [16]; abbreviated to 80 item measure by Munster et al. [22] (Called BSHS-A); BSHS-B revised by Blalock et al. [31] (40 item); which is similar to the Revised Version of the Burn Specific Health Scale (BSHS-R), but it also covers Sexuality and Hand Function.
Willebrand et al. [43]	Assess frequency of pruritis and role of personality traits and coping in prolonged pruritis in burn patients injured 1–18 years earlier	Cross-sectional, survey, retrospective	248 former burn patients treated at Uppsala University Hospital Burn Unit between 1980 and 1995	- 1 question used from Abbreviated Burn Specific Health Scale which reads: "My burn itches a lot" - Coping with Burns Questionnaire (CBQ) - Swedish Universities Scales of Personality (SSP)	- 42% reported no pruritis; 44% reported occasional pruritis; 15% reported persistent pruritis Problems: Did not provide any reliability or validity information or total number of questions on Abbreviated Burn Specific Health Scale.
Willebrand et al. [36]	Explore how former burn patients react to filling in a trauma-related survey and whether reactions are related to individual factors	Mixed Methods: descriptive, correlational, retrospective, with single qualitative question	78 recovered burn patients treated at Uppsala University Hospital between 1996 and 2000	- Social desirability subscale of Swedish universities Scales of Personality (SSP) - BSHS-B - Hospital Anxiety and Depression Scale (HADS) - Impact of Events Scale-Revised (IES-R) - Qualitative open-ended question: "What was it like for you to answer these questions?"	- Interrater agreement of content analysis: 0.91 - Responses coded and categories collapsed into: Positive (55%), Effort (32%), Negative (13%) - Negative group had significantly more problems with nightmares and arousal than positive group - Positive group had significantly lower mean than Effort and Negative groups on Adventure seeking and Verbal Trait Aggression - Positive and Effort groups had significantly lower means than Negative group on Trait irritability - The Negative group had lower ratings than Effort group on Interpersonal relationships signifying poorer family relations - Overall, negative reactions found in small subgroup of participants displaying more maladaptive personality traits and PTSD symptoms

Dyster-Aas et al. [44]	Investigate long-term health and work status after work-related burns	Descriptive, correlational, cross-sectional, retrospective	86 patients treated for burns (TBSA >10%) between 1980 and 1995 at Uppsala University Hospital Burn Center	- BSHS-B (40 item) + pain scale from BSHS-A (1 question)	- 86% were working (15 not working: nine on sick leave or disability, six unemployed) - Those not working reported more problems with pain, reported poorer burn-specific health status in the psychosocial domain of BSHS-B scales Body Image, Affect, and Interpersonal Relationships
Willebrand et al. [45]	Explore relations between social desirability and health in former burn patients	Descriptive, correlational, retrospective	84 recovered burn patients treated at Uppsala University Hospital 1996–2000	- Social desirability subscale of Swedish universities Scales of Personality (SSP) - BSHS-B - Hospital Anxiety and Depression Scale (HADS) - Impact of Events Scale-Revised (IES-R) - Sociodemographic and Injury-related variables	- No significant correlations between social desirability and the HADS, IES-R, or BSHS-B - Mean score of social desirability was close to Swedish norm with no relationship to sociodemographic or burn characteristics - Inspection of data suggests nonlinear relationship in which those with normal degree of social desirability reported a better health status than other groups.
Wikehult et al. [46]	To evaluate the perceived need for care and degree of utilization of care in a group of severely burned patients with indications of health problems several years after the burn injury	Descriptive, correlational, cross-sectional, retrospective	69 patients treated for burns (TBSA >10%) between 1980 and 1995 at Uppsala University Hospital Burn Center	- BSHS-B - Swedish universities Scales of Personality (SSP)	- Sample had perceived worse burn-related health on all BSHS-B subscales ($p < 0.001$) - All participants had utilized health care after discharge from burn care (54% with general practitioner, 73% with plastic or hand surgery specialists). No factors influenced health care contact in regression models. - Of those receiving care, they had significantly lower scores in 3 domains of BSHS: Simple abilities, work, and Hand Function; and had higher scores on stress susceptibility, lack of assertiveness, and neuroticism on SSP - 80% described one or more functional restrictions - TBSA accounted for 41% in variance in current healthcare utilization.
Kildal et al. [47]	Determine the relationship between coping strategies and burn injury characteristics, sociodemographics and long-term outcome	Descriptive, correlational, retrospective	161 burn patients TBSA > 10% treated at Uppsala University Hospital between 1980 and 1995	- BSHS-Brief (BSHS-B): 40 items, nine domain scale used to assess health status. Cronbach's alpha varied between 0.76 and 0.94 - Coping with Burns Questionnaire - Sociodemographic Questionnaire	- Participants who were employed used less Avoidance coping; those living with a partner reported less use of Revaluation/Adjustment, avoidance, self-control, and instrumental action than those living alone - Avoidant coping and emotional support were the most important coping strategies
Sgroi et al. [48]	Investigate if recovered burn patients have fear-avoidance beliefs and to explore the association with psychological and somatic symptoms	Descriptive, correlational, retrospective	84 recovered burn patients treated at Uppsala University Hospital between 1996 and 2000	- Three questions from Tampa Scale of Kinesiophobia - BSHS-B: 40 item - Impact of Events Scale-Revised - Hospital Anxiety and Depression Scale - Coping with Burns Questionnaire	- BSHS-B subscale work had the highest correlation to fear-avoidance beliefs - Work, Heat Sensitivity, arousal had strongest relationships to fear avoidance beliefs

Table 1 (Continued)

Authors (date)	Purpose	Method	Sample	Instruments	Outcomes
Low et al. [49]	Evaluate the method of asking burn survivors about nightmares as a screening tool for the presence of PTSD symptomology	Cross-sectional, survey, retrospective	85 former burn patients treated at Uppsala University Hospital Burn Unit between 1996 and 2000	- One question used from Abbreviated Burn Specific Health Scale which reads: "I have nightmares" - DSM-IV criteria for nightmares - Impact of Event Scale-Revised	- Sensitivity, specificity, discriminant ability, and Likelihood Ratios for a positive and negative result were calculated to evaluate the screening questions - The BSHS item had higher discriminant ability, greater detection and exclusion strength compared with the DSM-IV based questions. Problem: used one question from BSHS-abbreviated version and provided no reliability or validity information for the original scale
Noble et al. [7]	Investigate psychosocial outcomes following electrical burns	Cross-sectional, survey, retrospective	22 electrical burn patients recruited after discharge from regional adult burn center and from attendees at a safety conference for electrical workers	- BSHS-brief version (BSHS-B): assesses burn patients' QOL as total score across four scales: Physical Function, Social Function, Mental Function, and General Well-Being - Coping with Burns Questionnaire (CBQ) - Pain Patient Profile (P3)	Results specific to BSHS-B findings: - Participants with high voltage burns >1000V had worse Sexuality scores ($p < 0.05$) - Participants with burns >10% TBSA had significantly worse scores in Hand Function, Body Image, health sensitivity, and treatment regimens ($p < 0.05$) - Participants with burns >20% TBSA had significantly lower scores in areas of Sexuality, Body Image, Heat Sensitivity, treatment regimens and work satisfaction compared to those with smaller burns ($p < 0.05$) - Participants surveyed after 5 years from injury showed significant improvements in physical function scores but scores remained low in work satisfaction and affect ($p < 0.05$) Problems: Article did not state how many questions in BSHS-brief version or psychometric properties of instrument
Willebrand et al. [50]	Investigate fear-avoidance and neuroticism regarding burn patients associations with post-burn health	Descriptive, correlational, retrospective	84 recovered burn patients treated at Uppsala University Hospital between 1996 and 2000	- BSHS-B - Four questions from The Tampa Scale of Kinesiophobia that measure fear-avoidance beliefs - Swedish Universities Scales of Personality (SSP) - Sociodemographic and injury-related variables	- Injury-related fear avoidance is associated with both physical and psychosocial aspects of burn-specific health, especially perceived ability to work - Neuroticism significantly associated with seven of nine domains and remained significant in Affect, Interpersonal relations, and Sexuality in three multiple regressions - Injury-related fear avoidance was related to all aspects of perceived burn specific health in bivariate associations and remained significant in 6 multiple regressions (simple abilities, Hand Function, Heat Sensitivity, work, treatment regimens, Body Image)

Moi et al. [8]	Identify self-reported sociodemographic factors and comorbidities as well as injury specific factors that could predict long-term impaired physical and psychosocial burn-specific health and identify factors for long-term post-burn unemployment.	Descriptive, correlational, cross-sectional, retrospective	95 patients admitted to Haukeland University Hospital Burn Center	- BSHS-N: 80 item translated BSHS-A - Sociodemographic and comorbidity questionnaire
BSHS, Burn Specific Health Scale; CES-D, Center for Epidemiologic Studies Depression Scale; STAI, State-Trait Anxiety Inventory; RADAR, rapid assessment of disease activity in rheumatology.				

However, limitations emerged over the course of psychometric testing that led to the development of other versions of the instrument. Blalock et al. [30] conducted a qualitative study to test the content validity of the BSHS-A by comparing the content of the instrument with the types of problems elicited from interviews with survivors of burns. Results demonstrated that while the BSHS-A adequately addressed problems associated with appearance, mobility, psychological well-being, hand function, and social relationships in survivors of burns, it did not adequately address problems with skin, work, treatment regimens, pain, and itching. Furthermore, Blalock et al. [31] identified a lack of discriminant validity between the body image and affect subscales and determined that the length of the BSHS-A placed undue burden on the respondent and limited its utility in the clinical setting.

3.3. Burn Specific Health Scale-Revised

To address these limitations, Blalock et al. [31] took the BSHS-A and added 29 items to assess areas that were inadequately covered. Participants rated the extent to which these additional items described them on a five point Likert scale with endpoints of 1, "extremely well" and 5, "not at all". Measurement tools used for validation analysis included the Center for Epidemiologic Studies Depression (CES-D) Scale and Speilberger's State-Trait Anxiety Inventory (STAI). An identified lack of discriminant validity suggested that many of the original items on the BSHS-A were misclassified within the subscales. Principal component factor analysis followed by orthogonal rotation to simple structure yielded a seven-item set comprising 31 total items (17 from the original BSHS-A and 14 added items). A six factor solution explained 72.3% of the variance [31].

The revised subscales were less highly intercorrelated than the original BSHS-A with no correlations exceeding an alpha of 0.70. The subscales in the BSHS-R yielded high levels of internal consistency reliability with Cronbach's alpha ranging from 0.82 to 0.94. However, factor analysis of this instrument suggested a lack of discriminant validity between the Affect and Body Image subscales. A second identified limitation was that the BSHS-R did not specifically cover the domains of Sexuality and Hand Function, which previously had been identified as important factors in QOL for burn survivors [29].

Blalock et al. [32] were the only researchers to use the BSHS-R, in a study that examined factors associated with psychological distress in burn injury survivors and their relationship to rehabilitative outcome expectations and the perceived importance of improvement. Surprisingly in this study, the researchers used the work and simple functional abilities subscales along with a five-item measure of pain to create a composite variable rather than testing the entire BSHS-R and reporting the psychometric properties of the instrument using this sample.

3.4. Burn Specific Health Scale-Brief

Recognizing the need for a shorter instrument that could be used in the clinical setting without sacrificing the important factors that are critical to measuring burn specific health outcomes in survivors of burn injury, Kildal et al. [33] used a

factor analytic approach on the BSHS-A and BSHS-R to further improve the scale for clinical use. In their statistical analyses, these researchers were able to replicate the seven factor findings of Blalock et al. [31] but with a clear separation between Affect and Body Image subscales. Factor analysis of the BSHS-R with nine items added from the BSHS-A to represent Sexuality and Hand Function yielded nine well-separated domains, with factor intercorrelations ranging between 0.11 and 0.56 and with Cronbach's alphas ranging between 0.75 and 0.94. The result was a 40 item, nine factor structure represented as Heat Sensitivity, Affect, Hand Function, Treatment regimens, Work, Sexuality, Interpersonal Relationships, Simple Abilities, and Body Image, which explained 72% of the variance [33]. It is important to note that each of the domains are internally consistent and can be used as separate clinically meaningful subscales to evaluate post-burn patients.

More recently, Willebrand and Kildal [34] performed a second order factor analysis of the BSHS-B and discovered a simplified domain. Their goal was to improve its value in routine clinical work. Subsequently, the underlying structure of the BSHS-B was comprised of three clinically relevant broader domain structures: affect and relations, function, and skin involvement. The work subscale was excluded from analysis because of consistent double loadings; therefore, it was considered to be a separate outcome domain. All intercorrelations for the nine subscales of the BSHS-B were statistically significant ($p < .001$) and ranged from 0.15 to 0.65. Communalities of the nine subscales were adequately explained by the three-factor model.

3.5. Utility: a comparison of the BSHS-A, BSHS-R, and BSHS-B

In 2002, Kildal et al. [29] performed a statistical comparison of the abbreviated, revised, and brief versions of the BSHS on 248 post-burn patients. Scores on all three instruments were highly correlated: least between the BSHS-A and BSHS-R ($r = 0.81$), higher between the BSHS-A and BSHS-B ($r = 0.86$) and strongest between the BSHS-R and BSHS-B ($r = 0.98$). Internal reliability for all scales was high with Cronbach's alpha for the BSHS-A ranging from 0.75 to 0.96; the BSHS-R from 0.75 to 0.93; and the BSHS-B from 0.75 to 0.93. The results demonstrated that that all three versions provided similar results at the group level; however, respondent burden was considerably diminished by the shorter BSHS-R and BSHS-B versions. Hand Function and Sexuality were better covered in the BSHS-A and BSHS-B and Heat Sensitivity was better covered in the BSHS-R and BSHS-B. From these evaluations, it appears that the BSHS-B version measures burn specific health most comprehensively with the least amount of respondent burden.

4. Areas of concern

A few problems emerged within the literature regarding appropriate use and description of the BSHS. Some authors described the number of questions on the BSHS but failed to identify the version (abbreviated, brief, or revised) used in the

study [10,28]. Others failed to describe any of the psychometric properties of the instrument used [7] and none of the researchers discussed how missing data should be handled in the analyses.

Each version of the BSHS covers specific domains related to burn outcomes and few researchers and clinicians are knowledgeable about the domains and subdomains of the instruments, scoring requirements, or psychometric properties for each version. Therefore, it is imperative that researchers state the version used in their study, the health and functional domains covered in that version, scoring, and associated psychometric properties. Additionally, a review of the psychometric properties of the different versions draws attention to inadequacies and advancements in instrument design. Perhaps by consistently emphasizing the psychometric deficiencies and respondent burden of the BSHS-A within the literature, there would have been fewer language translations of this version and greater use of shorter versions in clinically relevant studies and translational research.

Another issue uncovered in this systematic review was that some researchers chose only to use certain questions from a subdomain or shortened the subdomain by a few questions to decrease respondent burden [35,36]. Subsequently, the psychometric properties of the shortened instrument can be called into question because the variance within the concept under investigation may be minimized and the predictive validity and reliability of the findings may be in question, thereby limiting generalizability [37,38].

5. Conclusion

This systematic review has highlighted the evolution and psychometric testing of the BSHS from inception to its current form. Reduction of burn mortality rates only intensifies the importance of questions about the QOL that may be achieved by burn survivors. After years of refinement, researchers in the field of burn management and rehabilitation have developed the BSHS to accurately capture the unique rehabilitation and QOL issues of this patient population. Adaptation of the instrument over time has been critical to making the instrument relevant and useable within both the research and clinical environments.

It is important to determine the purpose of using a specific version of the BSHS, research or clinical assessment. Additionally, examining the various versions of the BSHS for utility in longitudinal research of burn patients is important. Patients' adaptation over time and the effect of time post-burn are rarely studied factors that may have critical importance. However, the response burden related to the BSHS version used may affect participant recruitment and retention in such research.

Having an understanding of the validity and reliability of the various versions of the BSHS is critical before embarking on inquiry into the QOL outcomes of burn survivors. Furthermore, issues of scoring and missing data must be examined. Because domain scores are derived by dividing the summed domain items by the total score, missing data on one question from a domain that has only three questions, such as

Sexuality, can markedly affect the results. Currently, the BSHS in some form is the most commonly used instrument to examine QOL of burn survivors. Clarity regarding the components and use of the versions of the BSHS will strengthen burn QOL research.

Conflict of interest

None of the authors associated with this manuscript have any financial or personal relationships that would affect the contents of the paper.

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